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JPRS-CPS-85-066

2 July 1985

China Report

POLITICAL, SOCIOLOGICAL AND MILITARY AFFAIRS

INTRODUCTION TO NATIONAL
DEFENSE MODERNIZATION

CHAPTER IV

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2 July 1985

INTRODUCTION TO NATIONAL DEFENSE MODERNIZATION CHAPTER IV

Beijing GUOFANG XIANDAI HUA [NATIONAL DEFENSE MODERNIZATION] in Chinese
Jul 83 pp 37-84

[Chapters 1-3, 9 and Table of Contents of this publication were published
in JPRS-CPS-85-011 of 4 February 1985]

Chapter IV MODERNIZED ARMIES

[Text] 1. Today's Armies

Armies are principal arms of military services which fight land wars. However, the modernized army has been developed into a combined force made up of different service arms. For example, the Soviet Russian Army consists of motorized infantry, tank forces, rocket (or guided missile) units, artillery, AAA units, engineering, signal, and chemical warfare units; its total strength (including headquarters personnel) is 57 percent of their total armed forces. In the case of the U.S. Army, there are mechanized infantry, armored (tank) forces, artillery, engineering, signal, army aviation, reconnaissance or observation units; its total strength is about 40 percent of the country's armed forces. These countries' armies are lavishly equipped with tanks, armored vehicles, tactical guided missiles, nuclear weapons, aircraft, self-propelled artillery, anti-air missiles and highly efficient equipment for command control. Furthermore, all their forces are motorized and consequently, their armed forces' mobility, firepower, combat and assault strengths and independent combat efficiency are prominently increased.

Since World War II, an army's weapons and equipment have gone through extensive changes. The major changes are as follows:

A. Ever since major ground battles were fought with tanks and armored vehicles, all countries' ground forces have been highly armored and motorized. Presently, the Soviet Army has more than 50,000 tanks, 55,000 various types of armored vehicles and many other types of vehicles. Thus, in a motorized infantry division, on the average, there is a car for every 3 persons; in a tank division, an average of one vehicle for every 2.6 persons. During World War II, there was one motor vehicle for every 53 persons in the Japanese Army but the proportion was improved to one car for every 5 persons in the 1960's. In a U.S. Army division, there is one car for every 3-4 persons.

B. The formation of a ground fire neutralizing system is composed of field artillery, rockets and surface-to-surface tactical guided missiles; a ground force is not only equipped with a large number of artillery pieces but the weapons are also rapidly becoming self-propelled. By employing the combination of air defense guided missiles, self-propelled AAA and other field anti-aircraft weapons, the army can organize an open field air defense into a low, medium and high altitude fire net to provide the protection for a larger area than before. Presently, the Soviet Army has more than 40,000 different types of field artillery pieces, 1/4 of them are self-propelled; more than 6,000 air defense guided missile launchers; 8,000 AAA pieces of different types, about half of which are self-propelled.

C. Ever since the anti-tank guided missile, anti-tank gun, anti-tank mine, anti-tank rocket, tanks and armed helicopters have been incorporated into the anti-tank warfare, there have been many different ways to fight off a tank attack. The Soviet Army has more than 30,000 anti-tank guided missile launchers; NATO countries have more than 60,000 anti-tank weapons and more than 17,000,000 anti-tank projectiles. The armed helicopters have been considered as a highly mobile "airborne artillery force"; about 10 percent of the world's military helicopters are armed helicopters.

D. Electronic technology has been widely used in fire control, communications, intelligence operations, reconnaissance and combat command. This technology has raised the capacity and quality of military communications, improving the weapons' accuracy, remote control, and automation, increasing the effectiveness of night reconnaissance, night combat and all-weather combat and expanding the scope of electronic warfare. It directly induced the changes and innovations in weaponry and many new weapons, such as laser, particle beam and microwave weaponry.

Due to the innovations in weaponry and military equipment, an army's combat strength has been greatly upgraded:

(1) When the infantry is equipped with vehicles, they can have high mobility both in deployment and in combat--in the past, the infantry was a foot-soldier unit; after World War II, infantry was motorized, but as the soldiers were vulnerable to enemy attack and had to fight alongside tanks, the armored personnel carrier was developed. Although an armored personnel carrier can get through difficult terrain, provide reasonable protection and can be integrated easily into a tank column, the troops on the carrier still have to dismount to enter into combat action. In the 1970's, the armored assault vehicle, such as the Soviet Union's BMP infantry assault vehicle, was developed (see Illustration 4-1). This type of armored vehicle is similar to a tank. It not only protects the troops against gun fire, hand grenades and artillery shell fragments but is also equipped with guided missiles, cannon, machine guns and/or rocket launchers. The troops on board can fire the weapons through gunports in four directions; the vehicle can maneuver on all types of terrain and is amphibious. This type of assault vehicle has "three protections" [not specified, probably referring to firearm, nuclear and chemical] and is equipped with radio communications; each vehicle can seat a squad of 7-8 soldiers; the squad leader is the vehicle commander and the

squad can carry out combat actions on board the vehicle without dismount. Thus, the armored assault vehicle fundamentally changed the infantry's traditional role as foot soldiers.

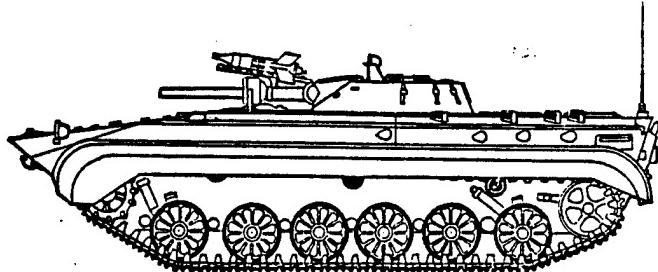


Illustration 4-1. The BMP Infantry Assault Vehicle

(2) A "flying army" upgraded its mobility and striking power--for a long time, air warfare was carried out by the air force while the army conducted combat actions on ground. However, during the U.S. Army's invasion in Vietnam, they used helicopters extensively in mobile warfare and many other countries followed suit by equipping their army with helicopters. Nowadays, the U.S. armed forces have more than 10,000 helicopters; 8,000 of them are in the army. The Soviet Army has also increasingly used more armed helicopters to support its ground force. In their Class "A" regional force, they use helicopters as the infantry's "airborne assault vehicles" and "airborne armored carriers." Thus, the ground force not only can conduct its mobile combat actions in air but also can coordinate with tanks, armored assault vehicles and artillery in a ground/air combat operation.

(3) The increased firepower enhanced the army's long and short range fighting capabilities--for short range combat, a Soviet motorized infantry division can fire 1,500,000 rounds/min of light weapons which is three times more than the firepower at the end of World War II. In a short range combat, the firepower of tanks, armored assault vehicles, armored cars and anti-tank weapons has had different degrees of increase. The long range combat firepower has had greater degree of increase. For example, a modernized Soviet Army division's artillery firepower is 40 times greater than at the end of World War II; their artillery shell's destroying and killing power increased 4-10 times. As another example, a U.S. Army's 155-mm howitzer battery could fire 89.9 kg of high explosive to cover an area of 7,500 square meters in one barrage during World War II but in the mid-1970's, the same battery could fire 258.6 kg of high explosive to cover 25,000 square meters, a three-fold increase. Although the number of nuclear weapons is limited, their total TNT equivalent, damaging and killing power is very high. For example, a kiloton class nuclear shell's destroying and killing power on an exposed target in an open area can equal the firepower of a single barrage from seven battalions equipped with 155- or 203-mm artillery.

Because of the above-mentioned major changes a modern army can engage in both conventional and nuclear war. It can operate freely day or night, on a plain,

in mountainous regions, in jungles, in deserts or in a swamp area. In a word, a modern army has the capabilities of engaging in many types of war.

2. Rapidly Developed Main Battle Tank

A tank is the modern army's major weapon and primary assault force, and it has been referred to as the "king of land battles." The development of modern tanks has proceeded by leaps and bounds since its first appearance in 1916. Nowadays, an army is equipped with a large number of tanks which are used extensively in battles. For example, in the 4th Middle East War in October 1973, both sides used more than 5,000 tanks; the tank battle was more ferocious than the famous tank battles at Kursk and Moscow in World War II.

The Soviet Union usually employs tanks as its forces' vanguard when invading another country. The examples are: 7,000 tanks were used to invade Czechoslovakia on 22 August 1968; more than 1,500 tanks and 2,000 armored vehicles were used to invade Afghanistan in December 1979.

Why does the tank occupy such a prominent role in war? The main reasons are it provides strong protection, has intense firepower and high mobility. It is well equipped for both defensive and offensive warfare; no other weapon can do so well in advance or retreat as a tank can.

A. Strong Protection

The unique feature of a tank is its strong and thick steel construction (generally referred to as "armor") which provides the strong protection. A modern tank has the following armor plates: front armor, rear armor, side armor, top armor, bottom armor, turret armor, etc. The most vulnerable area of a tank is its front and the front part of its turret and therefore, the armor at those areas are thickest. For example, the Soviet T-72's turret front armor (see Illustration 4-2) is 275 mm thick and it is curve shaped so that an incoming round could be bounced off. The T-72's front armor is 204 mm and is constructed to have a 22° horizontal inclination, thus doubled the strength of the armor. In other words, to penetrate the armor, an armor-piercing shell must have the power to penetrate 200-500 mm armor. In general, a tank's side armor is about 70-80 mm while its top, bottom and rear armors are about 20-50 mm thick because those areas are less vulnerable. However, since the development of the air-to-ground guided missiles, a tank's top armor has been strengthened to add its protection. A tank depends on the armored shell to protect itself against cannon shells and gun bullets to play its role of a warrior in a battle field.

In order to counter the improving anti-tank weapons' destroying power, there have been many innovations in the MBT's armor since the 1970's: (1) Development and application of laminate armor, i.e., two layers of metal plate of different hardness or two layers of metal plate with a non-metal material sandwiched in the middle. When an armor-piercing shell goes through different layers of armor, its piercing power would diminish layer after layer and in turn the tank armor's piercing resistance is greatly increased. The multi-layer armor could reach 200 mm in thickness without increasing the tank's

total weight too much. The T-72's upper front armor is laminate armor. (2) For better protection, the skirt armors are installed on both sides of a tank. When an anti-tank weapon strikes the tank, its skirt armor can shield from or waste the incoming round's armor piercing power. (3) Another way of protection is to seal the junction between the turret and the tank body, to install a ventilation and filter system to improve a tank's "three-way protection capability," so that a tank can stay in combat even under a nuclear weapon attack. (4) Making a tank lower in profile to minimize its size as a target is another protection. For example, America's new M-1 tank is 2.37 m high which is 1 m lower than the 1950's M48 tank; the Soviet T-72 tank of the 1970's is 2.19 m high which is more than 1/2 m lower than T-34 tank of World War II vintage. The world's lowest tank is Sweden's S-type tank which has no turret and is only 1.9 m high. (5) For better protection, a tank's ammunition and fuel are stored in isolated compartments to lessen the chance of self-destruction when taking a hit from an anti-tank weapon (see Illustration 4-3).

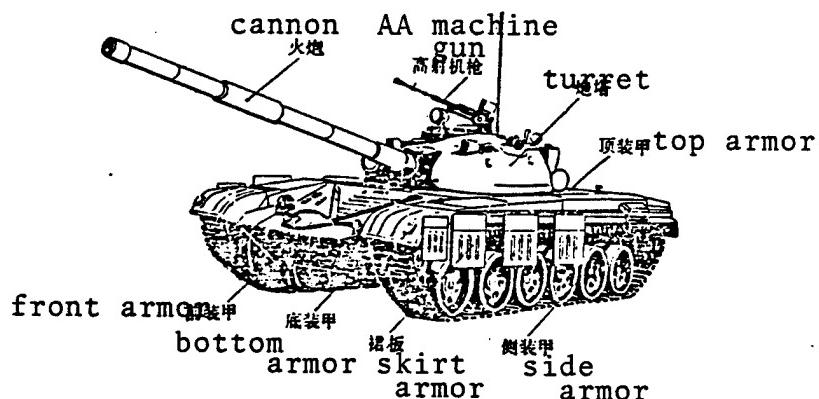
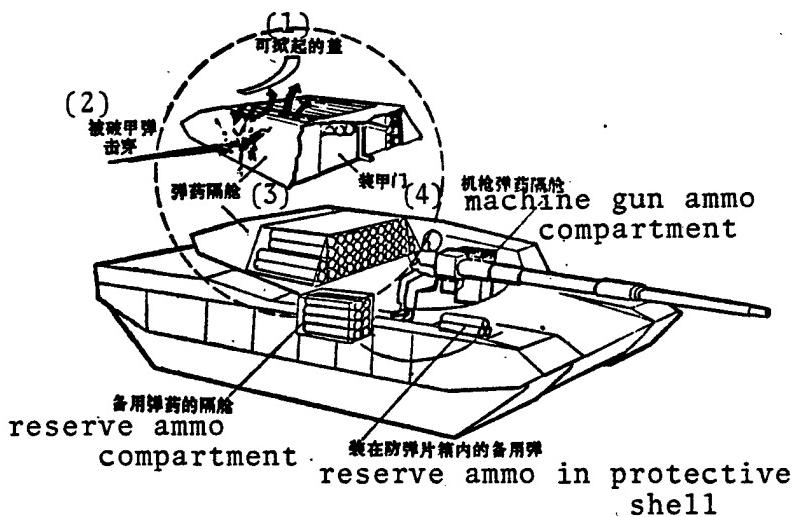


Illustration 4-2. T-72 Main Battle Tank



Key:

1. Popped out cover
2. Damage caused by armor-piercing shell
3. Ammunition compartment
4. Armored door

Illustration 4-3. Method of Ammunition Storage Inside the American M-1 Tank

B. A Tank's Intense Firepower

The modern main battle tank has tremendous firepower; its main features are as follows:

(1) Equipped with multiple types of weapon--a tank, in addition to its large caliber cannon, is equipped with coaxial and antiaircraft machine guns. The cannon can fire different types of shells or anti-tank guided missiles to destroy other tanks, armored vehicles and concrete defense works. It can fire its guns while in motion and has a 360° sector of fire. The anti-aircraft machine gun(s) are used to attack low-flying planes while the parallel mounted machine gun(s) are used to strafe the approaching enemy infantry.

(2) The large caliber cannon is a rapid firing accurate gun--tank guns used to be 76-90 mm in caliber during World War II but it has been increased to 100-123 mm. Since the 1960's, tank cannon caliber has been increased and its types also have been changed; for example, the adaptation of the smooth bore (no rifling) cannon made the tank gun more powerful because of its higher muzzle velocity; it can fire heavier payload and have longer range. In World War II, a tank could fire its gun only when it was stationary but a modern tank gun with its 2-dimension stabilizer can fire accurately while the tank is moving or even moving rapidly. In addition, a modern tank is equipped with a fire control system that includes laser range finder, trajectory computer and night vision sighting device, etc. The new system can observe, calculate [trajectory], aim and fire the gun accurately in all weather conditions. In addition to its accuracy, a tank gun is fast in operation; from the time of spotting a target to firing, only about 10 seconds is required and if the target is stationary, only 3-5 seconds are needed. According to a foreign journal [not specified], a tank gun with fire control can achieve more than 90 percent first round hits.

(3) Powerful ammunition--a modern tank's primary target is another tank or armored vehicle and therefore, tank ammunition is designed mainly for destroying armors. Generally, there are three types, i.e., high explosive, armor-piercing, armor-piercing capped projectile and the high explosive anti-tank projectile (see Illustration 4-4). A tank gun also fires regular high explosive shells. An armor-piercing projectile is made of high density steel alloy of tungsten or uranium with slender pointed nose. When on impact, the force is concentrated at the tip of the projectile and produces a tremendous pressure on a very small area of the tank armor; this penetrates the armor. A modern long-nose APDS projectile can penetrate 200-300 mm armor (see Illustration 4-5). After the projectile enters the tank, it still has high velocity and temperature; it can kill or wound the tank crew and induce an explosion from the tank's fuel and ammunition. This type of armor-piercing projectile is very effective ammunition to destroy laminate tank armor. The armor-piercing capped projectile is different from the high explosive type. This type of projectile produces high heat and velocity on impact to penetrate the armor. The projectile's softer portion penetrates 200-800 mm armor at the high velocity of 8,000-10,000 m/sec with a high temperature of 4,000-5,000°C (see Illustration 4-5). The high temperature of the projectile can kill or wound

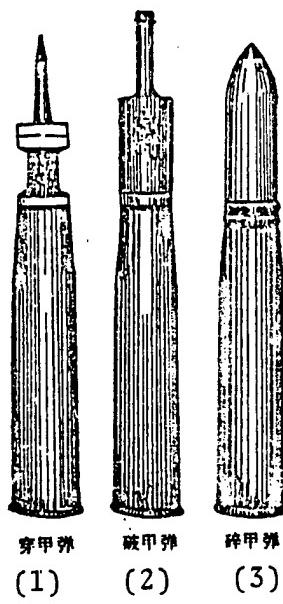


Illustration 4-4. Tank Gun Ammunition

Key:

- | | |
|--------------------------------|-----------------------------------|
| 1. Armor-piercing shell | 3. High explosive anti-tank shell |
| 2. Armor-piercing capped shell | |

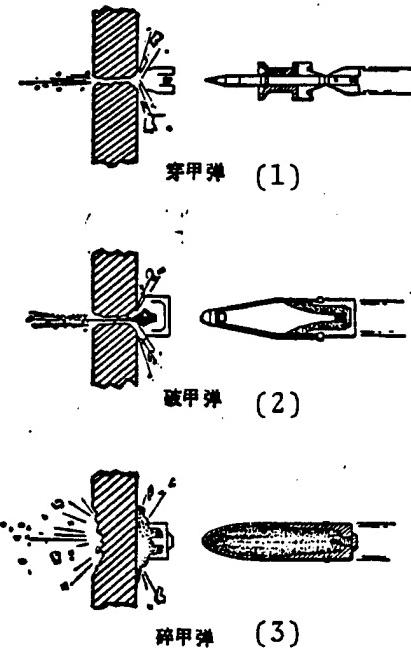


Illustration 4-5. Showing the impact of armor-piercing, armor-piercing capped and high explosive anti-tank projectile

Key:

- | | |
|-------------------------------------|--|
| 1. Armor-piercing projectile | 3. High explosive anti-tank projectile |
| 2. Armor-piercing capped projectile | |

the tank crew after entering the tank and can induce combustion of tank fuel and explosion of tank's ammunition. This type of projectile is also called "energy-concentrated projectile" or "hollow core explosive armor breaking projectile" and is commonly known as an armor-breaking projectile.

The high-explosive anti-tank projectile operates on a different principle as the armor-piercing or the armor-piercing capped projectile. It relies on the tremendous impact power produced by its explosive to tear open tank armor. This type of projectile uses shaped-charge explosive, such as pentolite, formed around a thin metal cone. A 122 mm HEAT round can carry up to 4 kg of explosives. On impact, the thin cone is flattened and its shaped-charge attaches itself on the armor plate like a piece of bubble gum and explodes; this explosion can produce a pressure as high as 100,000 atmospheric pressure on the surface of armor and induce a reverberating pressure on the reverse side of the armor; these two opposite violent forces can shatter 100 mm or more thickness of armor plate into many pieces and the flying pieces can kill and wound the tank crew and destroy the tank's interior. In addition, a tank gun can also fire an "arrow-shape shrapnel filled shell" which explodes only 3 meters out of the gun muzzle; the spreading shrapnel can kill or wound enemy troops near the tank.

C. A modern main battle tank usually weighs 40-50 tons; seemingly, it is a clumsy machine but it can move rapidly. On highway, its speed can reach 60-70 km/hr and it can move around freely in hilly or swampy country, on soft and muddy ground; can get over a 30° grade or a meter high wall; can cross a ditch of approximately 3 meters wide or a meter deep rapid stream; with some modifications, it can cross more than 5 meters deep river and it can travel 500-600 km with refueling (see Illustration 4-6).

How can a tank achieve such degree of mobility? Mainly, because of the following factors: (1) It has a highly efficient big engine. The T-72 has a 780 horsepower engine while the M-1 tank has a 1500 horsepower engine or more than 10 trucks' horsepower. Because of its powerful engine, it can move and accelerate fast, taking only 5-7 seconds to reach 32 km/hr from a standstill. (2) A tank's long and wide track covers a large area of ground, many times more than a truck's wheels cover; although a tank weighs 40-50 tons, it exerts less pressure on the ground than a wheeled truck and therefore, it can move on soft or muddy surface while a truck or jeep cannot. (3) A tank has good steering mechanism and power transmission. For instance, the M-1 tank uses electrohydraulic steering and hydraulic-mechanical transmission. It has good maneuverability; can make a full stop from 50 km/hr speed in about 3 seconds; can turn suddenly and can zigzag.

In view of these strong points of a tank, it can not only make full use of its firepower to increase its assault power, but also has high degree of survivability in battle.

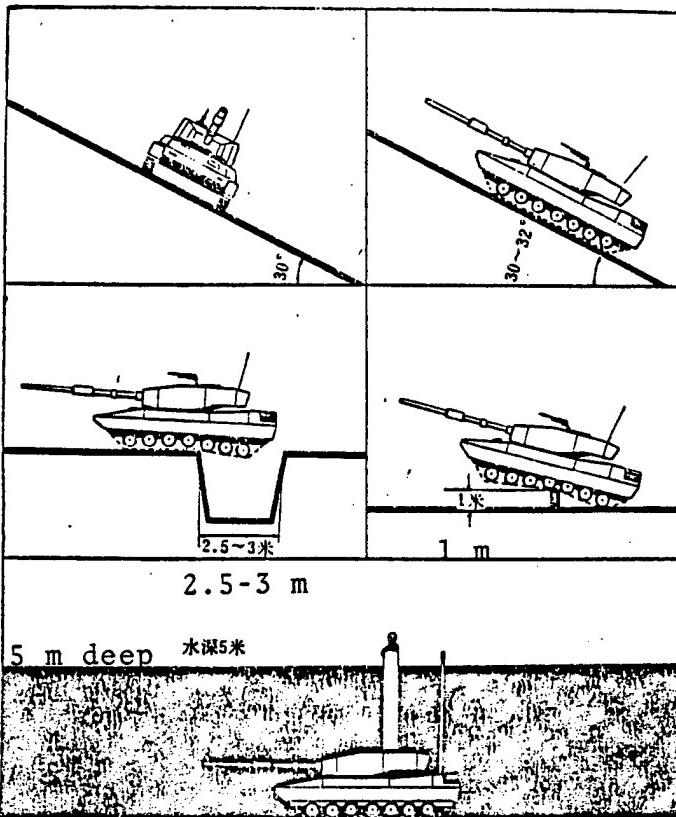


Illustration 4-6. Showing a tank's capability in the field

D. The might of a tank group--to employ several hundreds or thousands of tanks in a major campaign has been a common practice since World War II. Even though small-sized territory was involved in the 4th Middle East War, Iraq-Iran War, and Soviet Russia's invasion in Czechoslovakia and Afghanistan, they all used more than a thousand tanks; the highest number was 7,000 tanks.

When a large tank group goes into war, there are many other types of accompanying combat vehicles integrated into the assaulting tank columns to thwart enemy tank groups' block action, i.e., infantry's armored assault vehicles, self-propelled antiaircraft artillery, surface-to-air guided missile launchers, surface-to-surface guided missile launchers, tank group's self-propelled artillery, self-propelled rocket launchers, armored scout cars, armored command cars, mine-sweeping, bridge erection, emergency repair, ambulances, and other special-purpose vehicles (see Illustration 4-7). A tank group can break through enemy defense line; execute long-range assault, outflanking, deep-thrust, carving up and encircling enemy maneuver; carry out wide-front, deep-thrust attack and confront an enemy's tank group.

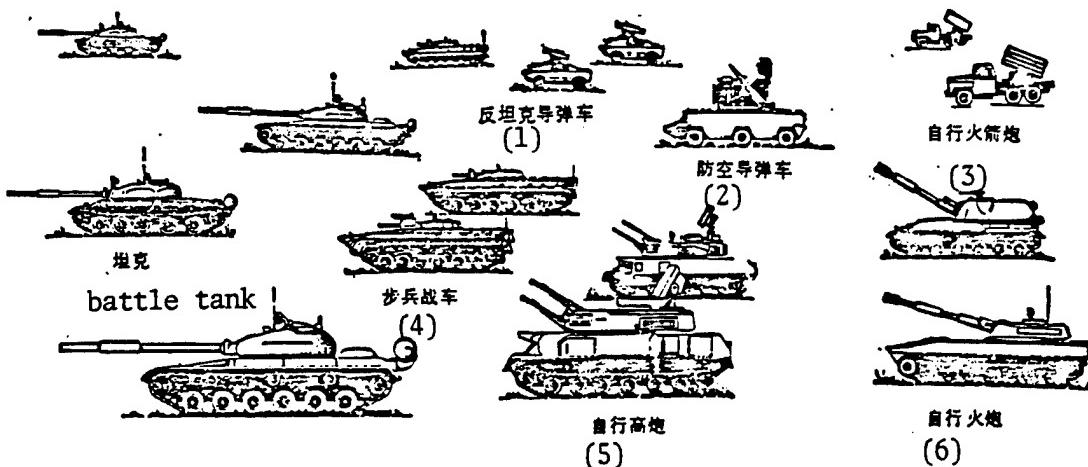


Illustration 4-7. Russian Army's Armored Column Assault Formation

Key:

- | | |
|--|--|
| 1. Anti-tank guided missile carrier | 5. Self-propelled antiaircraft artillery |
| 2. Antiaircraft guided missile carrier | 6. Self-propelled artillery |
| 3. Self-propelled rocket launcher | |
| 4. Armored infantry assault carrier | |

However, a tank has its weak points also. There is a saying "a tank has five worries": (1) because of its comparably thin armor on top and bottom, it is afraid of guided missiles, cluster bombs and anti-tank mines; (2) a tank's track, track sprocket, and road wheels are exposed parts and are vulnerable to artillery shell, rocket, explosive and mine. Although a tank has good mobility, its movement still can be hindered by mountain, river, complicated terrain, man-made ditch, tank trap and slanting tank obstacles; (3) a tank is loaded with fuel and ammunition and its engine is mounted on its rear; a direct hit can cause explosion; (4) a tank can carry a limited amount of fuel and ammunition; supply cutoff is another major worry; particularly, a large group of tanks moving forward depend on continuous fuel supply; without fuel, the powerful tanks become a heap of scrapped metal; (5) a part of the tank's optical and night vision instruments are exposed and without adequate protection can be easily destroyed; without vision, a tank cannot move. Therefore, a tank is not as terrible as it seems to be; aiming at its weak points, a tank can be destroyed in many ways.

3. Characteristics of Anti-Tank Weapons

In the last section, we described the tank's might, particularly a tank group's. Many military experts believed that in a modern war, the importance of anti-tank measures is second only to anti-nuclear weapons and that anti-tank measures are the fundamentals of a ground battle. The maxim is "to stop the tanks' advance equals to destroy the enemy's offensive." For this reason, all nations put a lot of effort in research, manufacturing and equipping anti-tank weapons. In searching for effective means to counter tanks and tank group attack, one must study the tank's weak points and an attacking

tank group's characteristics, equip and train all ground force units to have anti-tank or armored vehicle capability. In order to have three-dimension anti-tank warfare, all the anti-tank weapons of the ground and air, long and short ranges are combined and integrated into one system. When deploying anti-tank weapons, one has to place a strong force with intense firepower in forward position but should not neglect the deployment in depth with multiple staggered echelons.

Following is an example of anti-tank warfare:

At the range of 40-100 km, using tactical guided missiles and air raids to attack tanks at their assembly point to destroy part of the force;

At the range of 20-40 km, using rockets and mines to destroy the enemy force;

At the range of 4-20 km, using cannon, rocket and helicopter to attack them from land and air, to disrupt its formation, to slow them down, to destroy part of the tanks and armored vehicles and to create a favorable condition for the next stage of the battle;

At the range of 1-4 km, a major stage in the tank warfare, the defender's tanks engage the advancing enemy tanks. Anti-tank guided missiles and guns are also employed to stop the enemy, to inflict heavy casualties on the advancing enemy;

When the remainder of the enemy tank column reaches within 1 km of the defender's forward position, they should be eliminated by short-range anti-tank weapons, such as rocket launcher, recoilless rifle, rifle grenade, hand grenade, explosive satchel or canister (see Illustration 4-8).

There is a saying "every action produces a reaction." The hegemonist uses tanks as its "almighty weapon" to scare others, but the "reaction" is to use many means to destroy their tanks. According to statistics in the 4th Middle East War, 50 percent of the total tank losses on both sides were destroyed by anti-tank guided missiles and rockets, 30 percent were destroyed by tanks, and 20 percent were destroyed by anti-tank mines, cannons, aircraft, etc. From these statistics, we can see that anti-tank guided missile, mine, rocket launcher, etc. play a major role in a large-scale tank warfare.

Following is an introduction on several kinds of anti-tank weapons.

A. Anti-Tank Guided Missile

The guided missile, a new type of weapon, was developed from rocketry during World War II. When we say "rocket" which means a flying mechanism using rocket propulsion to make it move forward; after a rocket is fitted with a warhead, we call it a "rocket projectile" and when an automatic guiding system is installed on a rocket projectile, it becomes a "guided missile." The anti-tank guided missile, a type of tactical missile, was invented in the 1950's. Because of the missile's characteristics of long range, precision, armor-piercing ability, good mobility and simple operation, it has

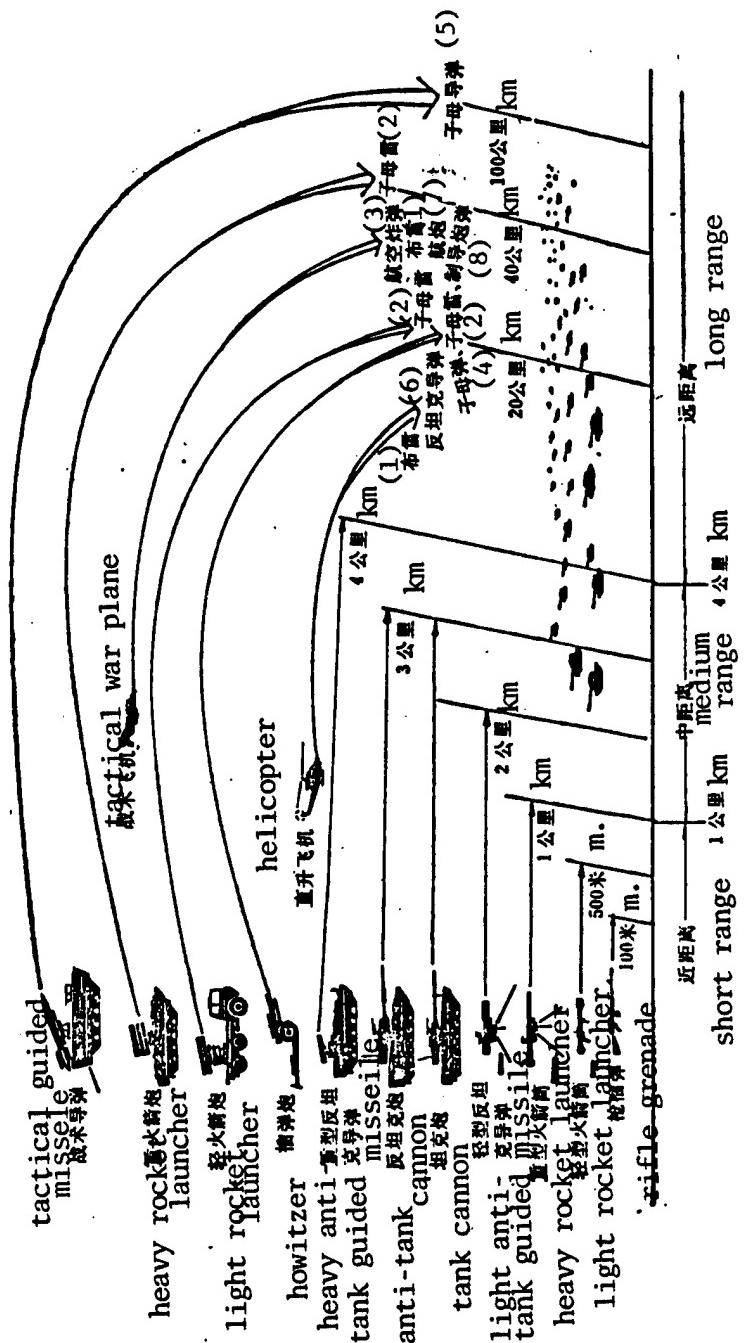


Illustration 4-8. NATO Countries' Anti-Tank Measures

Key:

1. Mine laying
2. Broadcasting mine
3. Aerial bomb
4. Canister projectile
5. Guided missile with canister warhead
6. Anti-tank guided missile
7. Aerial cannon
8. Guided artillery projectile

progressed to a third generation in less than 30 years. Military experts considered it a most effective anti-tank weapon and a "favorite pet." Many nations are producing scores of types of anti-tank guided missiles that have become standard equipment of their army. Our country also devoted major effort in developing the weapon and achieved good result.

The three generations of anti-tank guided missile had very little changes in construction except for its guidance system. The first generation of anti-tank guided missile (see Illustration 4-9) was developed in the 1950's. The Soviet Army's Sa-ka-er guided missile is a representation of that class of missile. This missile consists of a rocket, warhead, control mechanism, stabilizer, etc.; weighs about 11 kg; can pierce armor of 500 mm or more at a right angle impact. Its engine is a two-stage solid fuel rocket. At the time of launching, the 1st stage rocket is ignited to start it flying at a preset speed and then the 2nd stage rocket is ignited automatically to keep it flying. Its control mechanism has two parts; one part is on the missile while the other part is in the ground control box, the two parts being linked by a guide wire. At the time of launching, the gunner used the "cross-wire sight" to train the missile on the moving target so that the cross-wire center, missile and the target are on the same line of sight. Because it was hard to operate this missile, hard to train a gunner and of low efficiency, the 2nd generation of anti-tank guided missile was developed.

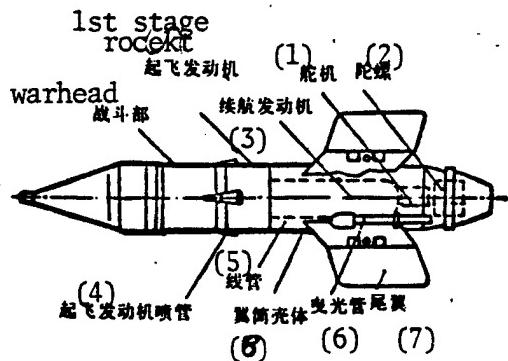


Illustration 4-9. The "Sa-ka-er" Type Anti-Tank Guided Missile

Key:

- | | |
|----------------------------------|-----------------------|
| 1. Directional control mechanism | 5. Guide wire tube |
| 2. Gyro | 6. Tracer tube |
| 3. 2nd stage rocket | 7. Tail fin |
| 4. 1st stage rocket nozzle | 8. Tail section shell |

The 2nd generation anti-tank missile was developed in the 1960's. France and West Germany jointly developed "Milan" and "Hote" missile, American "Dragon" and "TOW" missile being representative of this class. In comparison with the 1st generation missile, the 2nd generation added a launching tube, and an infrared instrument on the missile's tail section; the control box has an infrared detector and computer. At the time of launching, the gunner just aims the weapon at the target, pulls the trigger and the missile is launched

from the tube; then, the infrared instrument on the tail section sends out an infrared signal to the infrared detector via a guide wire; upon receiving the signal, the infrared detector determines whether or not the missile's trajectory is on the right course; if not, the computer would calculate the degree of deviation and send out a signal to make the correction (see Illustration 4-10). This guidance system not only greatly simplified the operation but also made the missile more accurate. Its percentage of hits reached 90 percent plus. Nowadays, many countries' armed forces are equipped with this type of anti-tank guided missile.

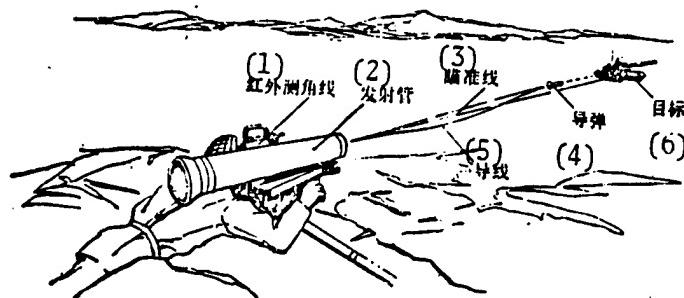


Illustration 4-10. The 2nd Generation Anti-Tank Guided Missile

Key:

- | | |
|------------------------|-------------------|
| 1. Infrared instrument | 4. Guided missile |
| 2. Launcher | 5. Guide wire |
| 3. Line of sight | 6. Target |

The 2nd generation anti-tank guided missile has two types, i.e., the light and heavy type. The light type is a portable missile, such as the "Milan." It weighs 6.65 kg; one person can carry the entire system while the assistant gunner carries two extra missiles. The light type's range is 2,000 m; it can pierce armor of 600 mm at 0 degrees; a tank can be destroyed with one or two such missiles. The "Hote" missile is a heavy type; it weighs 21.8 kg; can be mounted on a tank, armored vehicle or helicopter; it has a maximum range of 4,000 m; can pierce an armor of 800 mm at a right angle impact. An armored missile launcher can carry more than 20 missiles while an armed helicopter can carry 16 missiles. One of this type can destroy a tank if it hits the target.

The 3rd generation anti-tank guided missile was developed recently; its main difference from the older missiles is the elimination of guide wires and a higher degree of automation. Its guidance system uses a television, light beam or laser semiautomatic system. For example, the American "Hell Fire" anti-tank guided missile uses a semi-self-adjusting guidance system. The missile's weight is about 27 kg; its range is 8,000 m. At the time of launching, a separate laser generator sends out a laser beam to the target which bounces back the beam and the laser receiver on the missile guides the missile toward the target upon receiving the beam (see Illustration 4-11). This type of missile is usually launched by a helicopter.

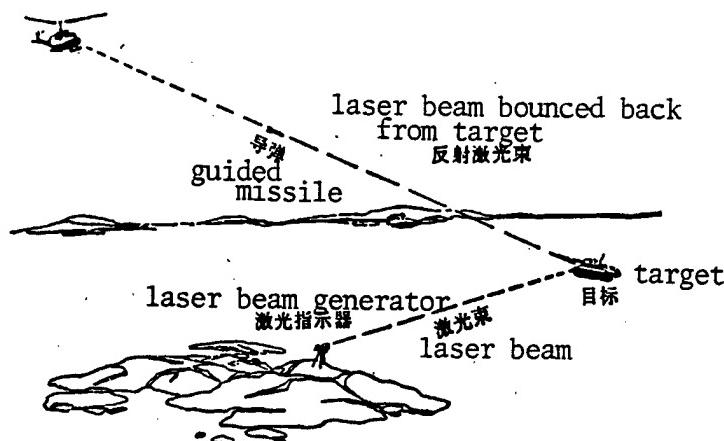


Illustration 4-11. Laser Semiautomatic Anti-Tank Guided Missile

B. Anti-Tank Mine

The anti-tank mine is a very effective weapon against tank columns. The densely planted mines on the route that enemy tanks must take can stop or slow down the tanks' advance or destroy them by large number. In World War II, the Soviet Army used more than 100,000,000 anti-tank mines to destroy more than 10,000 enemy tanks. Seventy percent of the total number of American tank losses in Vietnam were destroyed by mines.

There are many kinds of anti-tank mines, i.e., mines for damaging the tank track, chassis or sides. Anti-tank mine improvements follow the trend of innovations in tanks; it is a single-purpose defensive weapon to be used to counter an offensive weapon.

(1) Anti-tank track mine--this type of mine is designed to damage a tank's track. All the World War II anti-tank track mines were disc-shaped, mechanical pressure detonated mines (see Illustration 4-12). Its construction is fuse, explosive block and shell; it's simple in construction and easy to manufacture but is very heavy, about 7-8 kg; there were mines as heavy as 15 kg and therefore, it is hard to transport and to lay large numbers of this type of mines. Furthermore, it can only be detonated by a tank's track pressure and cause a limited degree of damage. The new type of anti-tank track mine is lighter, smaller and shaped like a lozenge stick. The West German's AT-1 mine has a length of 330 mm, a weight of 2 kg; it is also known as a "stick mine." This type of mine is usually planted in a hurry at the time of need by mine-laying machine or rocket; mines are scattered helter-skelter on the ground surface of a large area to increase the chance of being detonated by a tank's track. The objective of this type of mine is to slow down a tank column's advance.

(2) Anti-tank chassis mine--this type of mine was developed in the post-World War II era; it consists of fuse, explosive, casing, etc. and can pierce an armor of 50-80 mm. The older model of this mine used a plunger activated fuse; any part of a tank in contact with the plunger could detonate the mine

and the exploding mine could rip a hole on a tank's bottom to kill or wound its crew and to destroy the tank's interior. However, if there is no direct contact with any part of a tank, the mine would be harmless. To remedy this shortcoming, electromagnetic and sound wave type fuse were adopted for the mine. To thwart enemy's mine-sweeping operation by electromagnetic or sound wave method, the compound fuse was developed; this type of fuse can be activated by the combination of sound wave and vibration.

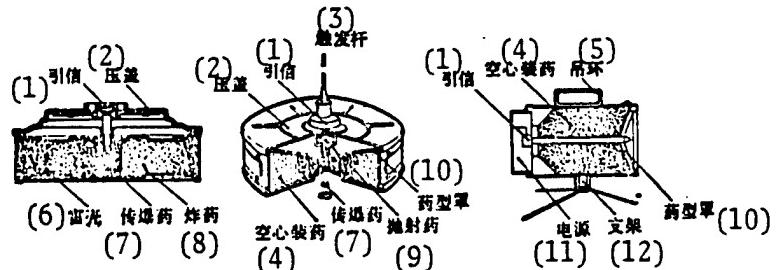


Illustration 4-12. Anti-Tank Track, Anti-Tank Chassis and Anti-Tank Side Mines

Key:

- | | |
|----------------------|----------------------------|
| 1. Fuse | 7. Booster charge |
| 2. Pressure plate | 8. Explosive |
| 3. Plunger (striker) | 9. Bursting charge |
| 4. Shaped explosive | 10. Explosive cone |
| 5. Handle | 11. Battery (power source) |
| 6. Shell | 12. Supporting frame |

(3) Anti-tank side mine--when terrain conditions restrict the application of anti-tank track or chassis mines, the anti-tank side mine can be used. In the early stage, this type of mine was converted from portable rocket launcher. The newer type mine (see Illustration 4-12) is mounted on a supporting frame and is planted on both sides of a narrow passage where enemy tanks must pass or is suspended on a tree. When a tank passes the area, the mine is detonated by an induction type fuse; its bullet-shape explosive cone is propelled toward the tank's side at a high speed and can penetrate 70-80 mm armor to destroy the tank's interior and harm its crew.

The above-mentioned three types of anti-tank mine can be planted manually; the miniaturized mines can also be scattered over a large area by an artillery shell, rocket, guided missile or an aircraft. The mines are basically defensive in nature but because of the improvements in planting mines, it became an offensive weapon. The artillery shell, rocket or guided missile's warhead that can carry and plant anti-tank mines are called mine canister and the mines inside a canister are called broadcasting mines. A mine canister can carry several to several hundreds of mines and an aircraft can carry a thousand or more mines. The broadcasting mines can be sown directly over approaching tank columns by means of artillery, rocket, guided missile or aircraft. A rocket company can sow enough mines to cover an area as big as scores of football field in 10-20 seconds to stall the tanks' advance and to trap them

in the area. In addition to the anti-tank mine canister, there is another anti-tank weapon which is very similar to the mine canister and is called an anti-tank canister (see Illustration 4-13). The anti-tank canister can be an artillery shell, a rocket, guided missile's warhead or an aerial bomb. This weapon is a projectile or bomb that contains many smaller armor-piercing shells; the shells can pierce 60-70 mm armor and are used to attack a tank's top. A 203 mm artillery canister can carry 195 smaller shells; when the canister bursts over a tank column, it showers the small armor-piercing shells on the tanks below (see Illustration 4-14). Each small shell has several nylon webs attached to it; the nylon webs can stabilize the shell's motion so that the shell's head points downward. If the shell hits its target, it can penetrate a tank's top to destroy its interior and crew.

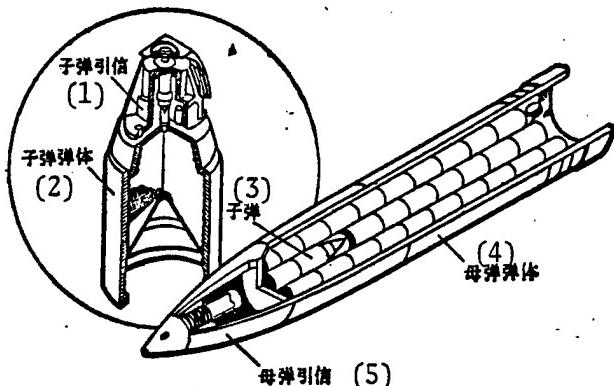


Illustration 4-13. The Construction of an Anti-Tank Canister

Key:

- | | |
|--|--------------------|
| 1. Fuse on the armor-piercing shell | 4. Canister's fuse |
| 2. Armor-piercing shell | 5. Canister shell |
| 3. Armor-piercing shells within a canister | |

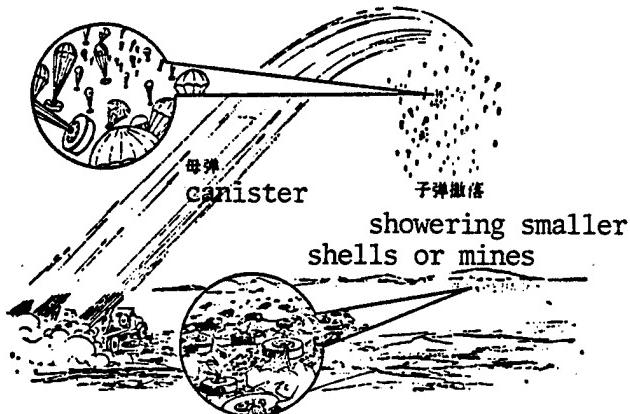


Illustration 4-14. Anti-Tank Canister or Anti-Tank Mine Canister in Operation

C. Anti-Tank Rocket Launcher and Recoilless Gun

Both the anti-tank rocket launcher and recoilless gun were developed during World War II. Although the two have different names and operate on different principles, they have similar characteristics and functions and therefore they are usually referred to as "light anti-tank weapons." Their common features are light weight, simple construction and controls; they became an infantry company's popular equipment and also the most effective short-range anti-tank weapon. These two weapons are also good for equipping large number of militias to achieve total anti-tank warfare. Both the anti-tank rocket launcher and recoilless gun's effective range is within 1,000 m.

An anti-tank rocket launcher has two parts, i.e., the launching tube and the rocket. There is a trigger and a sight mechanism mounted on the tube. The rocket consists of an engine and warhead which is armor-piercing. To launch the rocket, the gunner takes aim and pulls the trigger which ignites the engine to produce a powerful propulsion to propel the rocket toward the target at an accelerated speed.

There are two kinds of rocket launcher; one is light duty and the other is heavy duty. The light duty launcher is an individual operated portable launcher which fires a rocket of 1-3 kg; a person can carry 5-6 rockets. This class of rocket has a range of 100-300 m, maximum armor-piercing capability of 200 mm and can rip a 20-40 mm hole in a tank. This launcher is light and easy to operate; a soldier can launch a rocket at standing, kneeling or prone position. Some models of this launcher produce no visible smoke or flame at the time of launching a rocket; it is easy for a soldier to conceal the equipment in combat and is feasible for many foot soldiers to use the launcher in anti-tank warfare (see Illustration 4-15).



Illustration 4-15. Individually Operated Rocket Launcher

A heavy duty rocket launcher is equipped with a bipod or tripod, weighs about 10-20 kg, and is carried and operated by a crew of 2-3 persons. The rocket's maximum range is 300-1,000 m; armor-piercing capability is 200-400 mm; its warhead can be armor piercing, anti-personnel, incendiary type, etc. In order to make the launcher effective in night combat, many nations plan to install infrared or other types of night-vision sight on the launcher.

The recoilless gun was developed by combining the technology of a rocket launcher and a cannon. It is different from a cannon because it has no recoil. At the time of firing, part of the propellant gases is allowed to escape through the vent on the rear; the movement of escaping gas creates a forward thrust that cancels the recoil when the projectile moves forward; thus, the name of "recoilless gun." Because it has no recoil, there is no need of heavy recoil-absorbing mechanism; consequently, it is light; can be transported by manpower, horse, vehicle or airdropped. The weapon has good mobility and simple operation and therefore, it is suitable for short-range combat, ambush and anti-tank warfare.

Depending on caliber, recoilless guns are classified into three categories, i.e., large, medium and small size. A small caliber recoilless gun (under 60 mm) weighs only several kilograms and is in the same class as a light rocket launcher. It can be fired from the hands or on the shoulder. The medium caliber (60-100 mm) weighs about 10-20 kg and is in the same class as a heavy duty rocket launcher. It can be fired from a simple tripod or on the shoulder (see Illustration 4-16). The large caliber (over 100 mm) recoilless gun weighs 100-200 kg; can be mounted on a jeep [singularly] or on a light track-type vehicle in a cluster of several guns. The recoilless gun fires perforated armor-piercing cartridge which can pierce 200-400 mm armor. Currently, the largest recoilless gun is England's L6 model which is 120 mm; weight 295 kg; has a maximum range of 914 m and armor-piercing capacity of 400 mm.



Illustration 4-16. Recoilless Gun

When a recoilless gun fires a round, a portion of the propellant gases escapes through the gun's rear and thus decreases the pressure in the gun barrel and wasted a large portion of the explosive's power. Consequently, recoilless guns have lower muzzle velocity and shorter range than other types of gun. It produces a visible flash when it fires a round and therefore, concealing a recoilless gun in operation is hard.

The above-mentioned are specially designed anti-tank weapons. However, there are other kinds of weapon that can be used in anti-tank warfare, such as ground force artillery which has many other functions in the army and will be discussed in a separate section.

4. The Artillery--Being Gradually Converted to Self-Propelled Weapon

The ground force's artillery mainly consists of mortars, howitzers, cannons and rockets. They are the principal part of a ground force's firepower; their might was well demonstrated in World War II and the artillery was nicknamed as "war god."

Since the 1960's, artillery has undergone many innovations both in firepower and range; has been greatly modernized and has headed toward the objective of total self-propulsion. In a modern war, artillery is a very effective and important weapon for neutralizing enemy firepower; neutralizing enemy manpower; destroying enemy command post, observation post, communication center defense works, major roads and other important targets.

The modern army's firepower is composed of the following: Each battalion has a mortar company and its firepower range is 3-6 km; each division has an artillery regiment of howitzers and rockets and their firepower range is 20-30 km; a unit larger than an army corps has one artillery division, one rocket division and several guided missile units and their firepower range is hundreds of kilometers. The artillery firepower from units under a division are interlaced and overlap each other to form layers of cross-fire nets.

A. The Mortar

A mortar is the smallest artillery piece in the arsenal. Its distinctive features are sharp trajectory curve and short range. However, it is good for attacking targets that are out of line-of-sight and is good for area bombardment.

Based on caliber, mortars are classified as large, medium and small; over 100 mm is a large-caliber mortar; 81-82 mm is medium-caliber and 50-60 mm is small-caliber. Like other weapons, the mortar has been improved or innovated since World War II: (1) It became lighter and had longer range. By the time of the 1960's, a medium-caliber mortar could have the range and power of a World War II 120 mm mortar; (2) it has better mobility than before. Many countries mounted their large mortars on track-type vehicles or armored cars to become self-propelled mortars; (3) it became a multiple-purpose weapon by firing different types of projectiles, i.e., high explosive, illumination, smoke screen, target marker and anti-tank projectiles. Among the different types of mortar, the small-caliber has been improved faster than other kinds (see Illustration 4-17). There are three types of small-caliber mortar: (1) The basic model consists of mortar tube, bipod and base plate. Its total weight is less than 20 kg; maximum range is 3 km; (2) the basic model can be modified to become an individually operated weapon of 6-7 kg by eliminating its bipod and using a lighter base plate. The modified model is very good for close-quarter and street fight; (3) if a long mortar tube is used on a small-caliber mortar, it can become a long-range mortar and its range almost equals a medium-caliber mortar but is much lighter. Ammunitions for all three modified small-caliber mortars are interchangeable and therefore, its manufacturing process, supply, transportation, maintenance and service are simplified.

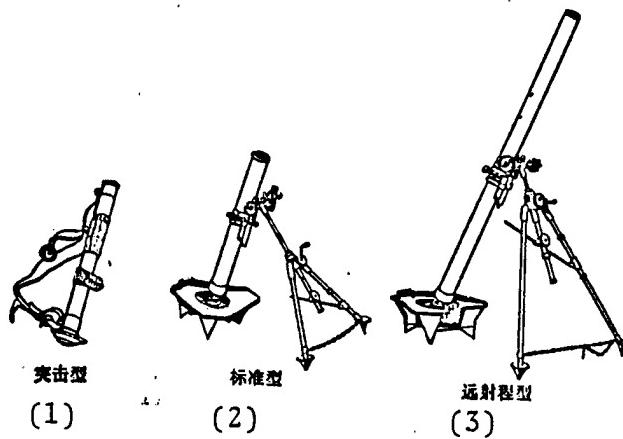


Illustration 4-17. Small-Caliber Mortars

Key:

- | | |
|------------------|---------------------|
| 1. Assault model | 3. Long-range model |
| 2. Basic model | |

B. Howitzer and Cannon

Howitzer and cannon are ground force's artillery for different purposes. Their names are developed from their different trajectories (see Illustration 4-18). A howitzer has sharper trajectory curve than a cannon and therefore, it is used to lob shells over mountain or other obstacles into enemy positions. A cannon's trajectory curve is very slight and therefore, it is also called a "flat trajectory gun." A cannon is suitable for anti-tank, anti-armored vehicle warfare and attacking an exposed target on ground level. A howitzer has a short and thick barrel, low muzzle velocity and consequently, shorter range. A cannon has a longer barrel, high muzzle velocity and longer range.

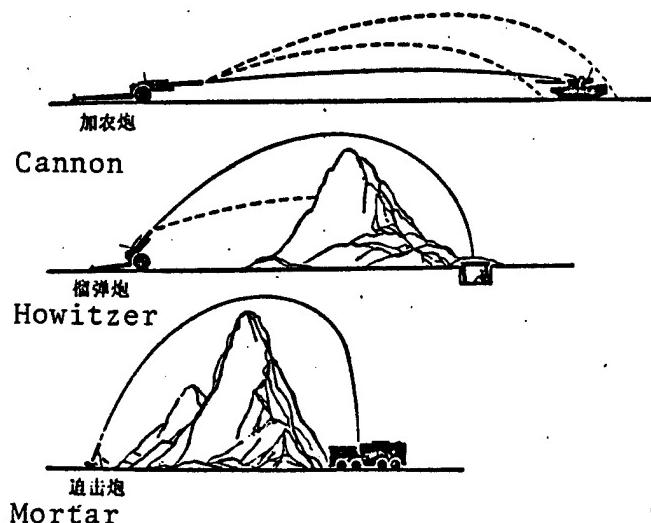


Illustration 4-18. The Cannon, Howitzer and Mortar

Both cannon and howitzer have their strong and weak points; so, many countries combined the two weapons' strong points and developed the cannon-howitzer. Since the 1970's, practically all new artillery pieces have been the cannon-howitzer and they have become the mainstay of field artillery (see Illustration 4-19).

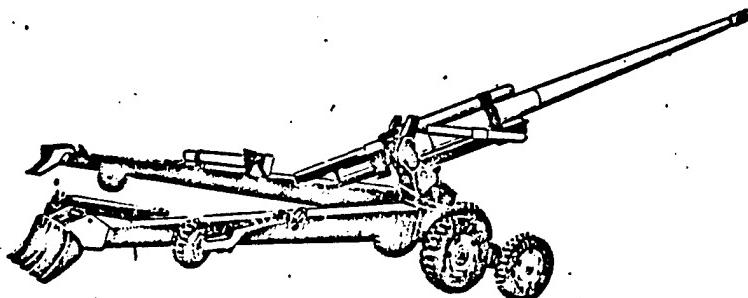


Illustration 4-19. The Cannon-Howitzer

In the post-World War II era, artillery pieces underwent great changes in better mobility and firepower:

(1) The trend of self-propelled artillery--in the past, all howitzers and cannons, each weighed several tons, were towed by trucks and couldn't get into poor terrain. On occasion, it was pulled and pushed into positions manually, a time-consuming and hard to accomplish mission. By the time of the 1960's, the self-propelled artillery appeared on the scene in great numbers and they can be deployed together with tanks and armored vehicles. The so-called self-propelled artillery (see Illustration 4-20) is an artillery piece being mounted on a tank chassis or other type vehicle chassis. It depends on its own motive power to travel and fires in a mounted position. In comparison with a towed artillery piece, a self-propelled howitzer or cannon is faster in movement and more versatile in cross-country capability. Because of the union of weapon and its carrier, a self-propelled artillery can move freely and rapidly; can be deployed quickly from one location to another and start firing in a short span of time and also can have amphibian capability. It can accompany tanks, armored vehicle and infantry assault vehicles in a lightning attack. The self-propelled artillery's carrier is armored to protect its crew from bullets and artillery shell shrapnel. A sealed self-propelled artillery has the "three protections" [probably referring to protections against gun fire, chemical and nuclear weapons] to protect the crew from harmful toxicant material and radiation; it can operate freely in a [chemical or nuclear] contaminated area and survives. Therefore, a sealed self-propelled artillery piece is suitable for both conventional and nuclear warfare.

The "self-towed" artillery (see Illustration 4-21) is the next best thing to a self-propelled artillery. A self-towed artillery is an old style artillery piece with a motor (known as "auxiliary propelling mechanism") installed on its trails for moving the piece in a short distance or in deployment. For a long-distance haul, it is still towed by a truck or tractor and also can be

airlifted by helicopter or plane. A self-towed artillery piece's maximum speed is 20 km/hr and can go up a 30° grade. Because it is easy and inexpensive to convert an old style artillery piece into self-towed artillery or to manufacture one, this type of artillery has been popular and rapidly developed.

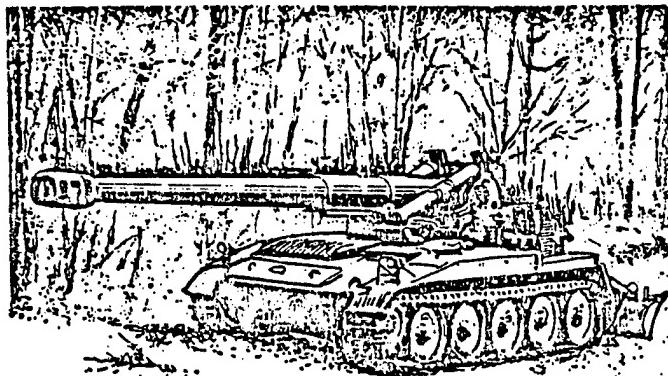


Illustration 4-20. Self-Propelled Artillery

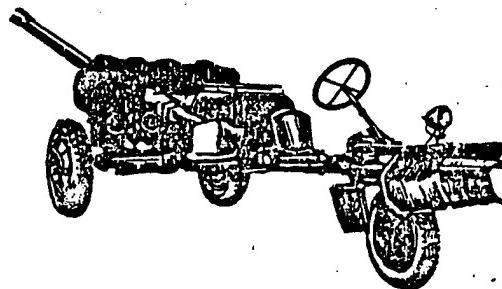


Illustration 4-21. Self-Towed Artillery

(2) Striving for rapid firing and longer range--due to the development of the sealed turret with 360° field of fire and automatic loader, the self-propelled artillery can fire faster than before. For an example, the French GCT 155 mm self-propelled howitzer can fire 8 round/min; an artillery regiment of more than 50 artillery pieces can lob 20 ton/min of high explosives. After many modifications, a modern artillery piece has longer barrel; uses more powder charge to increase propulsion pressure and muzzle velocity for longer range. The projectile's shape underwent changes also [to reduce friction]; for example, one kind of projectile shaped like a date which is pointed on both ends; another type of projectile can create a jet propulsion effect from its end to increase its range 20-30 percent and another type of projectile has a rocket engine attached to it; after the projectile travels a certain distance, the rocket engine is ignited automatically to boost its range about 30 percent.

(3) Better firing control and sight--modern developments in audio, video and other electronic technology added extra sensors in the artillery operation,

i.e., laser range finder, night-vision gun sight, projectory computer, etc. The above-mentioned devices not only make precise range detection, azimuth adjustment, terrain survey and firing but also give almost instant response. Helicopter and drone, equipped with observation and reconnaissance instruments, can provide artillery firing control with [firing] data or target azimuth from their observation and survey scores hundreds of kilometers deep in enemy territory. Furthermore, artillery projectile can have its own "seeing capability." For example, the American 155 mm howitzer can fire a laser beam controlled "Cobra shell" which is in reality a guided missile fired by an artillery piece; it can hit a target 20 km away with a deviation in error less than 0.4-1.0 meter which is 10-20 times more accurate than an ordinary shell.

(4) Various artillery shells and their damaging power--modern artillery is provided with many types of quick-response shells. The basic type is the high-explosive shell (all shells with explosive charge that make the shell case burst and fill the air with high-velocity jagged fragments and cause damages are called high-explosive shells). A modern medium caliber shell can cause as much damages as a large caliber shell could do in the 1950's. There are many other types of artillery shells; for example, the American 155 mm howitzer can fire hollow-core high explosive, nuclear, poison gas and date-pit shape shells, rocket boosted anti-tank or anti-personnel canisters.

C. Rocket

The rocket was introduced during World War II. It is an effective weapon against exposed target in an open area (see Illustration 4-22) and a high performance and powerful weapon. A rocket battalion equipped with 18 rocket launchers, can deliver 40 tons of explosives in one salvo; create a sea of fire to inflict damages on tanks and personnel; can plant anti-tank mines in a large area and also can be used to detonate enemy-planted mines in a large area to make it safe.

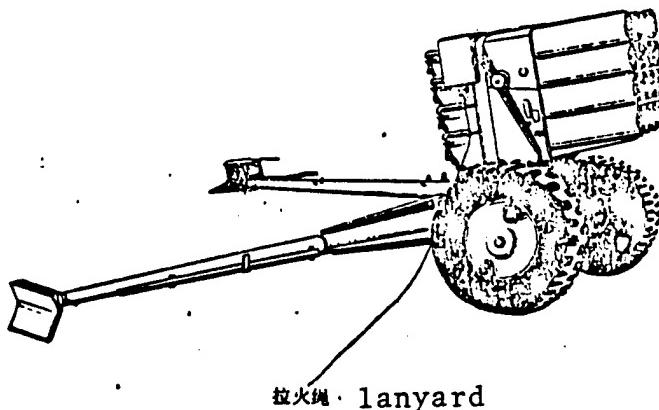


Illustration 4-22. Rocket Launchers

There are two kinds of rocket launcher, one is mounted on a carriage and is towed by a vehicle and another type is mounted on a truck or armored vehicle (see Illustration 4-23) which has higher degree of mobility; it can be redeployed within a short period of time after a launching.

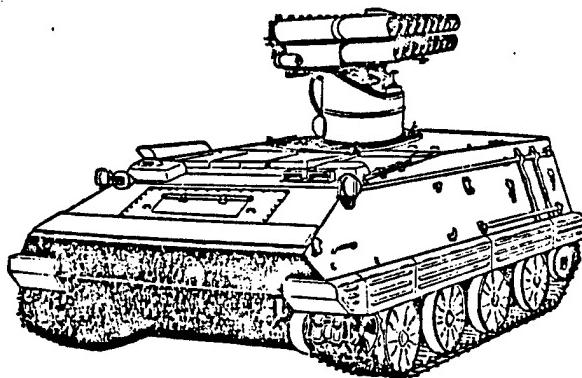


Illustration 4-23. Self-Propelled Rocket Launchers

The self-propelled launchers have a maximum speed of 75 km/hr and an operating range of 600-700 km [carrier's]. There are two methods of launching a rocket, i.e., by a launching pipe or by launching rail. Rocket launchers can be grouped together in a cluster of several or several tens of launchers. A rocket is a very powerful weapon; for example, the newly developed American multiple-rocket launcher is claimed to be the most powerful rocket launcher system in the world; this system is mounted on the XM-732 infantry armored vehicle; this system has 12 227-mm rocket launchers; one salvo from this system equals the firepower of 28 203-mm howitzers or two artillery battalions' guns firing one round.

A rocket usually has a range of 10-20 km; a rocket unit can launch 30-40 rockets in 20 seconds; each reloading requires 10-20 minutes. There are many kinds of rockets, such as anti-personnel, high explosive, chemical, incendiary, shrapnel-filled mine, shrapnel- or ball-filled projectile, napalm, smoke screen, etc. Rockets can be employed in many kinds of combat missions. Newly developed rockets in Soviet Russia and the United States have a range of 30-40 km; many countries are trying to upgrade their combat capability. However, a rocket weapon system is an easily exposed target [because it creates flash at launching] and is not a precision weapon.

D. Guided Tactical Missile

In addition to the above-mentioned artillery and rockets, there is another ground force's weapon which has the longest range and is the most powerful weapon, the surface-to-surface tactical guided missile. This weapon has been used to destroy stationary ground targets; however, some countries are trying to make improvements on this class of missile so that it can be used to attack moving target such as a tank or armored vehicle column.

A tactical guided missile system consists of missile and its ground equipment which includes launcher and guidance control equipment. The missile itself consists of warhead, control system, rocket engine, etc. There are two kinds of warhead, i.e., nuclear and conventional. The nuclear warhead is in the 10-1,000 kiloton class while a conventional warhead is in the several hundred kilograms of explosive class. Because a precision inertial guidance system is very complicated and expensive, a short-range tactical guided missile is usually using a simple, easy to operate and less expensive type of inertial guidance. When using a multiple-projectile canister warhead [on tactical guided missile] with a spread radius of 100-200 m, an automatic homing device is fitted on each projectile in the canister so that each projectile can zero in on a moving target. A tactical guided missile is either propelled by a single or two-stage rocket engine and the engine can be solid or liquid fuel type.

The ground-to-ground tactical guided missile also can be classified as stationary or mobile depending on its method of launching. The mobile type usually has a short range of around 100 km. The American "Lance" model is an example of this type; both the missile and its ground equipment are mounted on a motorized vehicle (see Illustration 4-24); it can carry a conventional warhead of 453.6 kg, a nuclear warhead of 211 kg (the 20-150 kiloton class) or a chemical warhead. The above-mentioned is also known as self-propelled missile and there is another type of mobile guided missile which is towed by a vehicle.

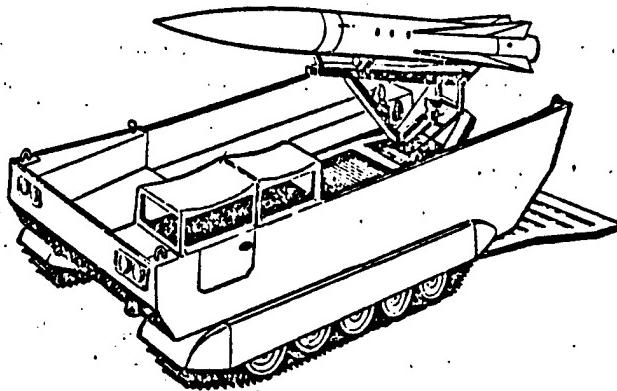


Illustration 4-24. Self-Propelled Guided Missile

The stationary type has a longer range of 700-800 km. The American "Pershing" model missile is an example; it has a complicated ground system which consists of control center, radio communication, data process equipment, power station, etc.; all are mounted on different vehicles. This missile is launched from a perpendicular position; flies through the atmosphere; comes down and hits the target.

5. Small Arms That Are Light and Easy To Use

Many local conflicts or limited wars after World War II proved that following large-scale armored force confrontation and intensive artillery duel, it was necessary for the infantry using small arms to annihilate the enemy and to occupy the land positions in order to achieve a victory and to conclude a war.

Traditionally, small arms [light weapons in Chinese language] are referring to rifle, machine gun, hand gun, etc., but in the modern army, small arms also include other types of weapon assigned to individuals, teams or squads such as hand grenades, rifle grenades, small caliber mortars, individually operated anti-air guided missiles, infantry's anti-tank guided missiles, anti-tank rocket launchers, light recoilless guns, etc. However, in this chapter we will discuss only the rifle, machine gun, hand gun, hand grenade, rifle grenade and grenade thrower.

A. Guns

The difference between a gun and artillery piece is the caliber size. Any weapon smaller than 20 mm is a gun and larger than 20 mm is an artillery piece. The guns can be classified into hand gun, rifle, submachine gun and machine gun. A hand gun is generally assigned to a commander or used by others for self-defense while rifle, submachine gun and machine gun are for combat. A modern rifle is usually automatic and also known as an assault rifle (see Illustration 4-25). It can fire automatically or semi-automatically. The Soviet Army's 5.45 mm AK-74 automatic rifle is an example of this type of weapon; it has a round muzzle recoil control and many parts on this rifle are drop-forged to make it lighter. The rifle's bullet has a "low, extended trajectory" and a muzzle velocity of 1,000 m/sec plus. The gun's effective range is 500 meters but the bullet still has penetrating power at 800-900 m range and there is no need to adjust the rear sight within the range of 400 meters.

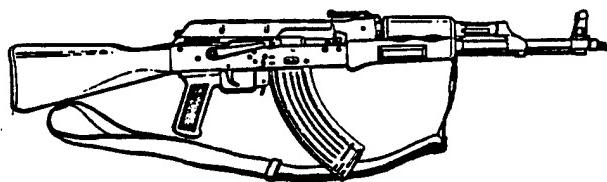


Illustration 4-25. Automatic Rifle

Modern machine gun has two types, the light machine gun for a squad and the general purpose machine gun (see Illustration 4-26). The squad light machine gun weighs 5-6 kg; has an effective range of 600 m and can fire either in full automatic or semiautomatic modes. Theoretically, the machine gun's firing speed could reach 600 round/sec.

The modern general purpose machine gun takes the place of old heavy machine gun to provide firepower support. It is mounted on a tripod but it can be operated on its built-in bipod as a light machine gun (see Illustration 4-27).

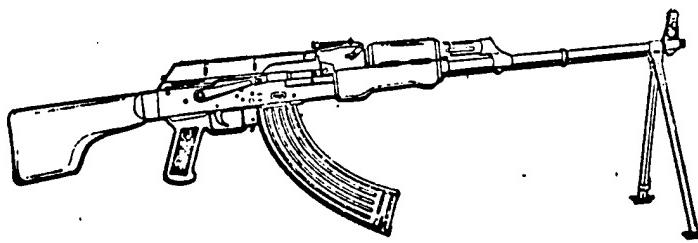


Illustration 4-26. Squad Light Machine Gun

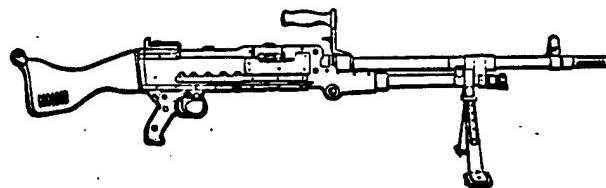
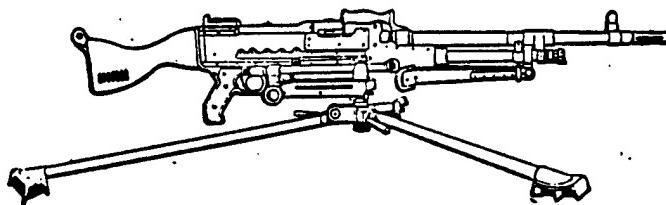


Illustration 4-27. General Purpose Machine Gun

An assault rifle is short, light and easy to carry; it has a large capacity box magazine, rapid firing action and intense firepower. This gun is able to inflict high casualty on the enemy in close-quarter combat and is particularly useful for reconnaissance, patrol, street fight and jungle warfare. It is a rapid firing weapon; can fire bursts in a left-right sweeping arc to kill and wound large number of enemy soldiers. All special troops are equipped with assault rifle.

The small arms development in the post-World War II era has the following three features: (1) new designs are grouped into gun families, (2) small caliber and (3) high rate of firing.

A family of guns, such as rifle, assault rifle, squad machine gun and general purpose machine gun, usually has a basic model and all gun parts in one gun family are unified and interchangeable but each gun in the family has a specific tactical purpose. For example, the Soviet Army's AK gun family is a successful one; its basic model is the AKM rifle which can be modified to become an assault rifle and if it is fitted with a longer barrel and a bipod, it became a light squad machine gun. All guns in one family have a standard construction, limited varieties of parts and 80 percent interchangeable parts. Therefore, they are easy to produce, repair and supply. The troops can be trained to use different guns in a gun family, to understand their functions and to drill with guns easily.

One of the important innovations in small arms is to reduce the caliber. All countries have different standards to reduce the size of caliber. There was a saying "any gun smaller than 7 mm is a small caliber gun" but nowadays, a small caliber gun is usually less than 6 mm. American Army's small caliber gun is 5.56 mm while Soviet's is only 5.45 mm. The prominent features of a small caliber gun are: less recoil, easy handling, accuracy in semi-automatic and full automatic firing. Also, the newer design of small caliber gun bullets will tumble having entered a human body, causing more damage.

Another innovation of modern guns is high firing rate. In World War II, rifle and semi-automatic rifle could fire 30 round/min in combat; the present day automatic rifle can fire 100 round/min. World War II's machine gun was claimed to have a rate of firing 300 round/min while the modern machine gun can fire 600 round/min, double the firing rate of old models.

There have been many new types of small arms, such as laser gun, helmet gun, liquid-charge gun, open-breach gun, etc. Among the new guns, the most noteworthy one is the laser gun. A limited number of these guns have been issued to troops [probably referring to foreign nations]. The laser gun in use now can burn troops' clothing and singe troops' skin, flesh and eyes at a certain distance. It is still in the developmental stage; the objective is to make this gun more efficient, to be less bulky and lighter. New developments in small arms ammunition are: caseless cartridge, multiple-bullet cartridge, arrow shape cartridge, "folding bullet" [sic] and "unenriched-uranium bullet" [sic]. The caseless cartridge has the bullet encased in the powder charge directly; such a design not only saves metal for making cartridge case but also makes the cartridge lighter; eliminates the operation of ejecting empty case during firing and minimizes the possibility of a jammed gun.

B. Hand Grenade and Rifle Grenade

Originally, there were two kinds of hand grenade, the offensive and defensive type. The current trend is to combine the two together; the French MDF model hand (rifle) grenade is used for both defensive and offensive purposes. The MDF model has three parts; M is the offensive grenade version which weighs 262 g. If a fragmentation jacket D is added on M, it became an anti-personnel defensive hand grenade MD; the D part weighs 152 g and the total weight of MD is 414 g. The rifle grenade version is MD plus a tail fin section F and total weight of an MDF rifle grenade is 490 g (see Illustration 4-28) and therefore, MDF model is a triple-purpose hand grenade.

Another trend in hand grenade development is miniaturization; for an example, the Dutch V-40 hand grenade is in the size of a ping-pong ball; it has a 40 mm diameter; weighs 120 g and can be thrown to a distance of 75 m (see Illustration 4-29). One person can carry 10 V-40's at the total weight of 1.5 kg and it is as effective as other types of hand grenade.

A rocket-grenade is also being developed; it is a hand grenade with a small rocket booster attached to it and it can be launched by hand. The range of a rocket-grenade is about 200 m and it is more accurate than a regular hand grenade.

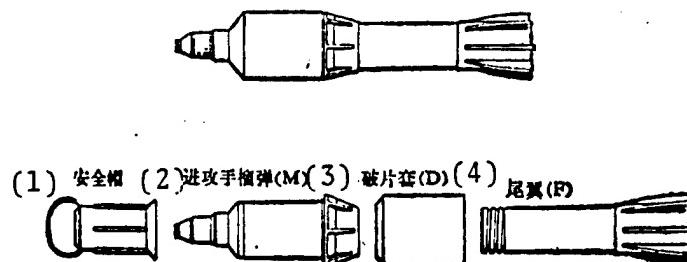


Illustration 4-28. The French MDF Triple-Purpose Hand (Rifle) Grenade

Key:

- | | |
|------------------------|---------------------------|
| 1. Safety cap | 3. Fragmentation jacket D |
| 2. Offensive version M | 4. Tail fin F |

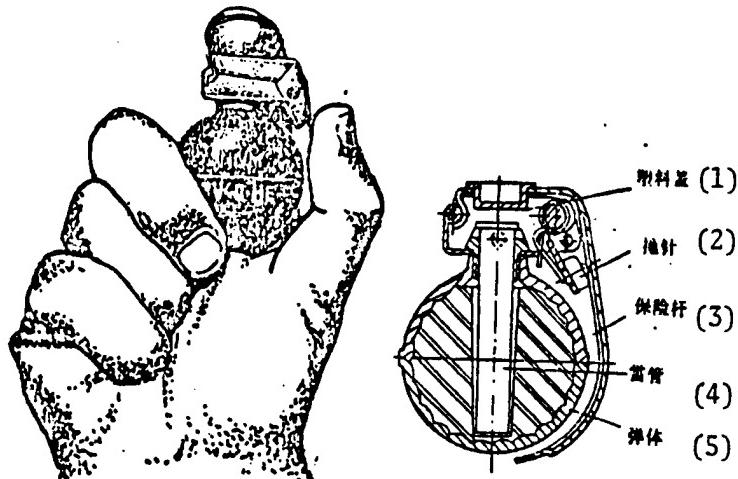


Illustration 4-29. Dutch V-40 Hand Grenade

Key:

- | | |
|------------------|-----------------|
| 1. Plastic cover | 4. Primer |
| 2. Firing pin | 5. Grenade body |
| 3. Safety level | |

The rifle grenade is a grenade to be launched by a rifle. There are two types of rifle grenade, the anti-tank and anti-personnel. Rifle grenade's effective range is about 100 m or more; damage power is slightly higher than a regular hand grenade and its anti-tank version has armor-piercing capability of 150-280 mm (see Illustration 4-30). The old type rifle grenade required an attachment on the rifle muzzle and a blank cartridge to fire it. A modern rifle grenade can be fired by a regular rifle without attachment and a regular cartridge. It is light, accurate, powerful and simple to operate. Many nations' infantry are equipped with rifle grenade and some of them even issue rifle grenades to troops in armored forces.

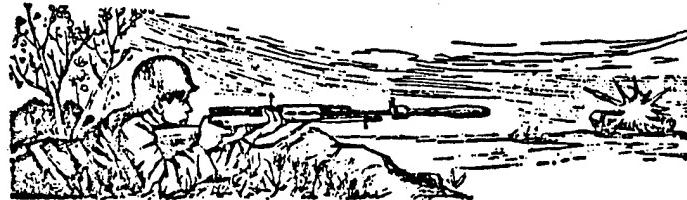


Illustration 4-30. Anti-Tank Rifle Grenade

C. Grenade Launcher

A grenade launcher has a cannon size caliber but is shaped like a small arm and uses an ammunition that equals the power of a hand grenade. This weapon is effective against individual emplacement, blockhouse gun ports, artillery emplacement, and marching formation and other area target; if equipped with armor-piercing ammunition, it can be used as a light anti-armor weapon and in a word, it is a multiple-purpose weapon also. The modern grenade launcher has three types, i.e., rifle type, rifle attachment type and machine gun type. A rifle type grenade launcher (see Illustration 4-31) weighs 2-8 kg; its effective range against an area target is 350 m while against a spot target is 150 m and its firing rate is 6-8 round/min.

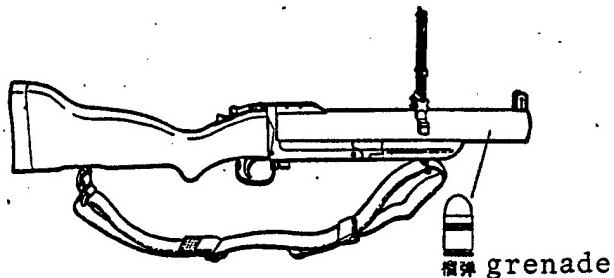


Illustration 4-31. Rifle-Type Grenade Launcher

The rifle-attachment grenade launcher (see Illustration 4-32) is a grenade launcher attached to a regular rifle. When the weapon is used as a rifle, the soldier pulls the rifle trigger; when it is used as a launcher, he pulls the launcher trigger but both weapons use the same sight to aim. This launcher and rifle combination is used for both spot targets and area targets.

The machine gun type grenade launcher (see Illustration 4-33) weighs 7.25 kg; has a 12-grenade magazine; is mounted on a tripod and has a firing rate of 90-100 round/min. In addition to the grenade launchers we have covered already, there is another type which has higher muzzle velocity, longer range than other launchers and has a belt-feed mechanism. This weapon has a firing rate of 300 round/min, 2,000 m maximum range and can be mounted on a vehicle or helicopter.

A grenade launcher can fire many kinds of grenades. In addition to the regular high explosive, there are grenades for armor-piercing, shrapnel or ball filled, signal and illumination type.

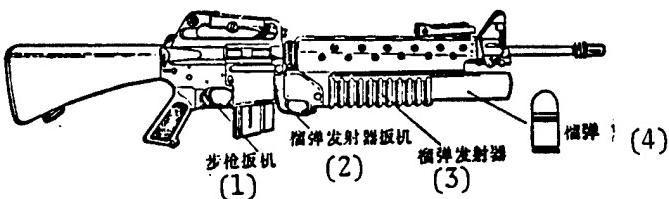


Illustration 4-32. The Rifle-Attachment Grenade Launcher

Key:

- | | |
|-----------------------------|---------------------|
| 1. Rifle trigger | 3. Grenade launcher |
| 2. Grenade launcher trigger | 4. Grenade |

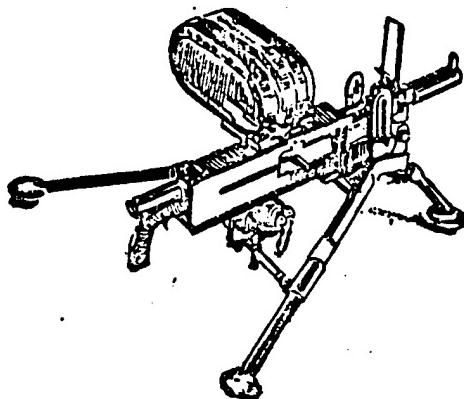


Illustration 4-33. The Machine Gun Type Grenade Launcher

6. New Field Antiaircraft Weapon

A complete air defense system includes the national air defense, field air defense and civil air defense. The main function of an air defense is to take actions and measures to fight off enemy planes. In this chapter, we discuss the field air defense only; the national and civil air defense shall be introduced in Chapter VI, "The Modernized Air Force."

The field air defense is a combat action to protect ground force in marching, garrison and combat. This defense uses ground-to-air weapons to fight off enemy aircraft and airborne attack. A field anti-air weapon should be mobile and quick in action. The new trend is to make the weapons self-propelled.

In World War II and up until the 1950's, antiaircraft weapons were mainly antiaircraft artillery of different calibers but since the 1960's, war planes have been improved tremendously; the large and medium caliber size AAA were not effective against the medium and high altitude flying planes. Thus, the fast, accurate and powerful anti-air guided missile gradually replaced the large and medium AAA. The multi-barrel small-bore rapid firing antiaircraft artillery and smaller and more mobile low-altitude and anti-air missile are used to shoot the low and super low flying war planes.

A. Mobile Anti-Air Guided Missile

The anti-air guided missile is also known as ground-to-air guided missile and can be classified into (1) 20 km plus high-altitude missile, (2) 3-20 km medium-altitude missile and (3) under 3 km low-altitude missile. The high-altitude missile has a very complicated guiding system; is designed for national air defense and is not discussed in this chapter.

The field air-defense guided missile system consists of medium and low altitude anti-air guided missiles; it is also called self-defense anti-air guided missile system. Both the medium and low altitude guided missile basically have the following components: rocket engine, control and guidance system, fuse and warhead (see Illustration 4-34). The main difference between this class of missile and the high-altitude missile is that the smaller guided missile has less complicated equipment and higher mobility than larger guided missiles. The medium and low altitude guided missiles are self-propelled; can locate a target and be launched while in motion. The system has a short interval between reloading and launching and can launch many missiles in one sequence to form a fire-net in the air.

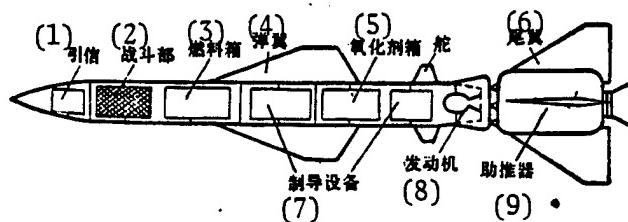


Illustration 4-34. Anti-Air Guided Missile

Key:

- | | |
|-----------------|--------------------------------|
| 1. Fuse | 6. Tail fin |
| 2. Warhead | 7. Control and guidance system |
| 3. Fuel tank | 8. Rocket engine |
| 4. Missile wing | 9. Booster rocket |
| 5. Oxygen tank | |

The medium and low altitude anti-air guided missile system is usually mounted on a specially equipped or armored vehicle; can move as fast as a tank, armored vehicle or self-propelled artillery and is also known as a mobile guided missile. This system is equipped with one scanning radar and one tracking radar or a combination radar of both scanning and tracking (see Illustration 4-35). The scanning radar can send out a radio beam continuously at the speed of light whether the unit is on the march or in camp. When the radio beam encounters a target, it will be bounced back and received by the same antenna. Based on the beam's travel time, the computer can calculate the target's flying direction, altitude and range. The radar also can tell how many targets its beam encountered and whether it is friend or foe. If the target is hostile, the tracking radar would take over automatically and feed the tracking data to the computer; the computer would send

out the firing order so that the missile launcher can aim the missile at the target's "future position" (or the "leading point") and the gunner on duty pushes the button to launch the missile. Once the missile is launched, the tracking radar starts to track the flying missile; the computer would compute the missile's flying course to make corrections if needed to guide the missile toward the target and to detonate the warhead within the effective radius of the target.

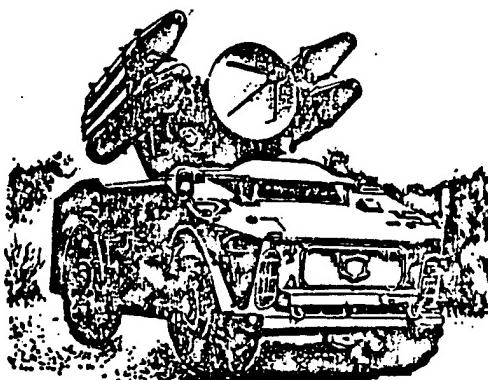


Illustration 4-35. Mobile Anti-Air Guided Missile

The low-altitude anti-air guided missile is a very simple antiaircraft missile. Its length is 1.5 m; weight is 10 or more kg; it can be carried and operated by one soldier and therefore has the name "single-soldier anti-air guided missile" (see Illustration 4-36). This weapon was developed in the early 1960's to counter low-flying or super low-flying airplane and was used in combat the first time during the 4th Middle East War. Egypt and Israel together lost close to a hundred helicopters, slow or low-flying planes because of the "single-soldier anti-air guided missile."

The single-soldier anti-air guided missile consists of a missile, missile launcher, launching mechanism and a battery pack. The launcher is portable in a carrying case and is reusable. The weapon can be fired from a person's shoulder. The gunner aims the launcher at a target; when the target is within the range of the sight, the launcher sends out a video-audio signal and the gunner pulls the trigger to launch the missile. This type of missile usually has a two-stage solid fuel rocket engine; the 1st stage rocket fuel is designed to be consumed within the launcher and the 2nd stage ignites after the missile is about 6-7 meters away from the launcher and therefore, the gunner will not be bothered by the loud noise or harmed by the flame. The missile's flying speed is 700 meter/sec or more and has an altitude range of 50-2,000 meters.

There are many kinds of guidance control system for the single-soldier anti-air guided missile; the most common one is a combination of optical sight and infrared tracking control system. This system is operated on the principle of pursuing the target by tracking the infrared beam radiated from the target's jet engine exhaust and therefore, this weapon can attack a target

from one direction only, the tail side. In the 1970's, a new laser beam guidance control system was developed and compensated for the shortcomings of the old system. The operating principle of this system is to transmit a laser beam toward a target and the missile will fly toward the tracked target by following the bounced back laser beam from the target. This system also includes a "friend or foe" detector to avoid mistake.



Illustration 4-36. Single-Soldier Anti-Air Guided Missile

B. Self-Propelled Small Caliber Antiaircraft Artillery

To counter the low or super-low flying planes, the small caliber antiaircraft artillery [AAA] has been proved to be very effective. In the 1960's, 60 percent of the U.S. Army's aircraft loss in Vietnam was shot down by the small caliber AAA.

The modern small caliber AAA (see Illustration 4-37) is usually mounted on a tank chassis carrier and therefore has a high degree of mobility, all-weather maneuverability and protection for the crew as good as a tank or armored vehicle.

While the small caliber AAA has been gradually converted into the self-propelled type, its firepower has also been increased and it is being improved to have a higher rate of firing, to fire more varieties of projectiles and to achieve better accuracy. In the 1960's, America was the first country to adopt electric feeding and the Gatling gun design on the 20 mm, 6-barrel AAA achieved the rate of firing at 1,000 round/min for each barrel. America's Vulcan 20 mm, 6-barrel AAA can fire 6,000 round/min.

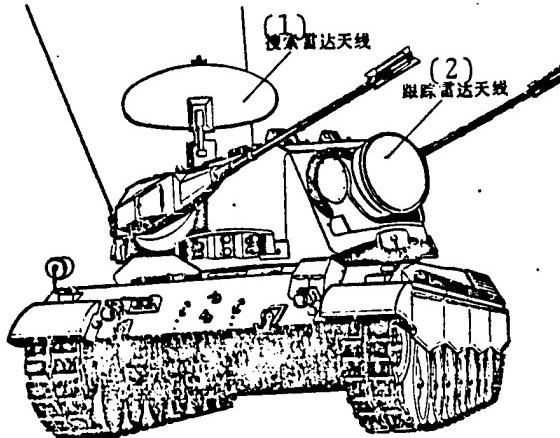


Illustration 4-37. Self-Propelled Small-Caliber Antiaircraft Artillery

Key:

1. Scanning radar antenna
2. Tracking radar antenna

The modern small-caliber AAA can fire many kinds of projectiles, such as high explosive, incendiary, armor-piercing incendiary, hardened steel core armor-piercing, etc. All the projectiles can cause damage on armor-plated or non-armored aircraft.

Similar to mobile guided missile, the self-propelled small-caliber AAA is also equipped with an automatic fire control system; this system consists of radar, computer, and the cannon's automatic-response power drive. This weapon has one feature which an antiaircraft guided missile does not have, i.e., when any part of the guidance control system on a guided missile develops trouble, the missile cannot be launched. However, the small-caliber AAA can be operated manually and fired even if the entire automatic firing control system is out of order.

Nevertheless, a small-caliber AAA is very expensive; a West German 35 mm double-barrel self-propelled AAA piece could cost several millions of U.S. dollars. Many nations are trying to develop a good performance but less expensive, non-all weather, towed AAA piece.

7. Night Vision Instruments

A modern army is required to fight a war in daylight as well as at night and therefore, their weapon and equipment are designed to meet the requirement that they can be accurately aimed and fired in darkness. To overcome the darkness and increase combat capability, the search light and illuminating projectile or bomb were employed in World War II. In the post-World War II era, Germany successfully researched and developed the infrared night vision instrument to be used on tanks. In the 1960's, the U.S. Army used micro-light night vision instruments in their invasion of Vietnam. Presently, all nations are paying particular attention to night vision research. Both

Soviet Russia and the United States have made good progress in the field and their forces are gradually being equipped with infrared, microlight, heat-wave image, etc. night vision instruments to increase their night combat capability.

A. Positive Infrared Night Vision Instrument

In the latter stage of World War II, the positive infrared night vision instrument appeared on the scene; by the 1950's this type of night vision instrument was used widely in the infantry artillery for observation, driving, aiming, etc., in darkness.

An infrared night vision instrument consists of infrared light sources, objective lens, infrared image converter, eyepiece, etc. In operation, the infrared light source emits the infrared beam which is not visible for human eyes, toward the target; the beam is bounced back by the target; through the objective lens, the bounced back beam is concentrated on the photo cathode of the image converter; the photo cathode converts the infrared beam into an electric signal and through the electrode an image is projected on a fluorescent screen. Military personnel depend on this image to conduct observation, aim and fire weapons (see Illustration 4-38).

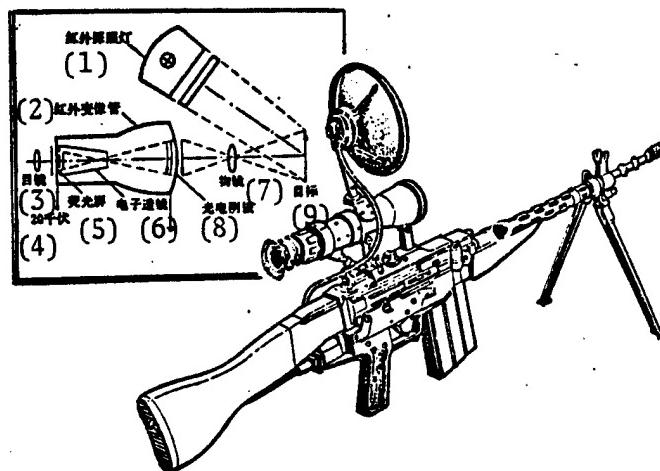


Illustration 4-38. Infrared Gun Sight on a Rifle

Key:

- | | |
|----------------------------|-------------------|
| 1. Infrared light source | 6. Electrode |
| 2. Photo cathode converter | 7. Objective lens |
| 3. Eyepiece | 8. Photo cathode |
| 4. 20 Kv | 9. Target |
| 5. Fluorescent screen | |

The range of a positive infrared night vision instrument depends on the power of the infrared light source. For example, the range of a rifle's infrared gun sight with a power of only 10-30 watts is 100-300 meters; a tank gun's

night vision gun sight, which has an infrared beam of 1,000 watts, can see a vehicle 2,000 meters away and a person 1,000 meters away.

The major shortcoming of a positive infrared instrument is that the adversary, equipped with positive infrared instrument also, can easily detect the presence of a unit which is operating a positive infrared night vision instrument. During the 4th Middle East War, both sides lost many tanks because one side used the positive infrared night vision instrument first.

B. Microlight Night Vision Instrument

This technology was a new discovery in the 1960's. The major component of this type of night vision instrument is the "image amplifier." If three image amplifiers are coupled in series, the arrangement can amplify weak light from stars or the moon to tens of thousands of times (see Illustration 4-39) and with this powerful light amplification, human eyes can see objects under very weak light from the moon or stars (see Illustration 4-40).

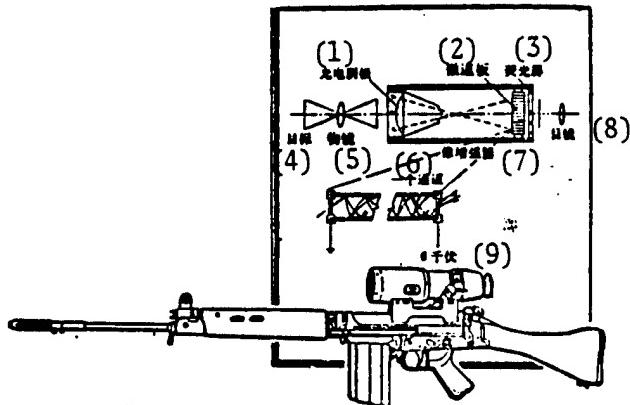


Illustration 4-39. Microlight Gun Sight

Key:

- | | |
|------------------------|--------------------|
| 1. Photo cathode | 6. One-way passage |
| 2. Micro passage plate | 7. Image amplifier |
| 3. Fluorescent screen | 8. Eyepiece |
| 4. Target | 9. 6 Kv |
| 5. Objective lens | |

The microlight night vision instrument is light in weight; does not expose the user and therefore, it is superior to the positive infrared night vision instrument. This instrument is gradually replacing the positive infrared night vision instrument and becoming the major night vision instrument in modern warfare. The British "Snipe" rifle with a microlight gun sight can see a person clearly 400 meters away under starlight and 600 meters away under moonlight.

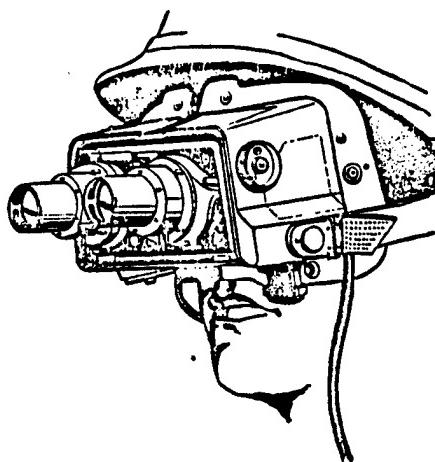


Illustration 4-40. Night Vision Goggles

If a tank is equipped with microlight night vision instrument, its crew's vision can extend to 1,000 meters under starlight and 2,000 meters under moonlight. Therefore, this type of night vision instrument can make the rifle and tank as versatile in nighttime as in daytime.

The British developed a "super range microlight night vision instrument" in 1977. This instrument enables a person to see a vehicle 10 km away under starlight.

If an image amplifier is attached to a television camera, it can record video under very little light. When U.S. forces were in the Sinai to enforce the ceasefire between Egypt and Israel, they used the microlight television system to carry out the night surveillance and they could see as far away at 16 km on the battlefield. When a microlight television system is mounted on a helicopter on a reconnaissance mission, the television camera can send back the video signal to a command post 50 km away and the video can be projected on a large TV screen so that many persons can view a night combat scene.

The microlight night vision instrument is better than infrared night vision instrument but it depends on moon- or starlight to operate and therefore, it is not effective in a cloudy or pitch-dark condition. In the 1970's, human beings showed off the ingenuity by inventing the "vista infrared" or the "thermal radiation image" system.

C. Thermal-Radiation Image Night Vision Instrument

There are many forms of thermal radiation image system but so far only the vista infrared system is very effective in application. The thermal-radiation image night vision instrument consists of infrared lens, plane scanning reflector, battery of infrared detectors, battery of luminescent diodes, optical lens, etc. The system's working process (see Illustration 4-41) is as follows: the infrared beam radiated from a target is collected on the infrared lens; the collected infrared beam is dissected by the plane scanning

reflector into a large number of dots which are sent toward the battery of infrared detectors by sequence; each infrared detector sends its signal through an electronic circuit to a correspondent luminescent diode and the battery of luminescent diodes produce a relatively visible light and this light is sent toward the optical lens by the reflection of the plane scanning reflector's reverse side. If a photocathode and a cathode ray tube are added on the system, the target image can be projected to a TV screen. This image is different from a TV picture because it does not indicate the lights, shadows and color of the target; it merely indicates the value of thermal radiation from the target, i.e., the lighter part indicates higher thermal value while darker part indicates lower thermal value. Sophisticated instrument can detect 1/1000 thermal value difference and therefore, can detect troops, vehicles, etc. through smoke, fog, rain, snow, camouflage or targets hidden by vegetation and forest or objects buried under ground. It also can tell whether or not a vehicle has been operated recently or can detect existing heat that was left behind by departed vehicles. Thus, the thermal radiation image system can see through all kinds of camouflage except high mountains and thick walls which can block the heat waves.

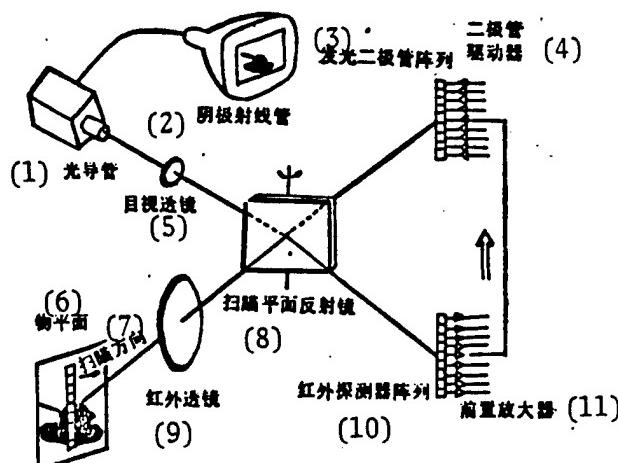


Illustration 4-41. The Working Process of an Infrared Radiation System

Key:

- | | |
|----------------------------------|-----------------------------------|
| 1. Cathode | 7. Direction of scanning |
| 2. Cathode ray tube | 8. Plane scanning reflector |
| 3. Battery of luminescent diodes | 9. Infrared lens |
| 4. Diode activator | 10. Battery of infrared detectors |
| 5. Optical lens | 11. Front amplifier |
| 6. Plane of an object | |

The latest version of thermal-radiation image rifle sight weighs about 3 kg and has a range of 1,000 meters. America's "TOW" anti-tank guided missile is equipped with a thermal-radiation image gun sight which weighs about 6 kg and has a range of 3,000 meters.

Presently, both the U.S. and Soviet Armies are equipped with night vision instruments; their rifle, artillery piece, anti-tank guided missile, rocket launcher and tank gun are fitted with night vision gun sights; their tank, armored vehicle and other motorized vehicle are equipped with night steering instruments; their command post and reconnaissance units are also equipped with night vision instruments and therefore, their armed forces' night combat capabilities have been increased tremendously.

Judging from the above-mentioned facts, we can see that the modern army's weapon and equipment have gone through many changes and innovations and also we can see the trend of changes for the future.

The overall picture indicates the direction of army weapons development: (1) greater effort in developing weapons' guidance and control systems, in increasing heavy weapons' self-propelled capability and accuracy; (2) in order to upgrade troop mobility and speed further, the number of motorized vehicles and their power should be increased greatly and in the meantime the mobility in three dimensions is improved continuously because of the increased utilization of the helicopter; (3) to increase weapons' range and firepower; (4) to increase electronic war power and night combat capability; (5) to simplify weapons and equipment's operational procedures, to standardize, systematize and universalize the weapons and equipment.

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